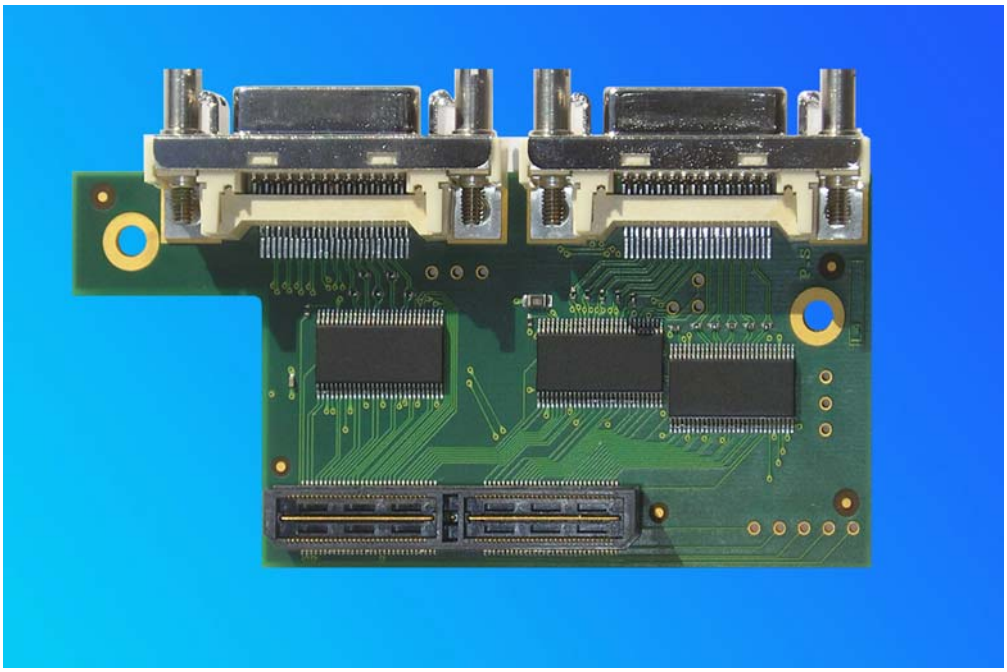
PROCCamLink IP



User Guide

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Introduction

PROCCamLink*™** IP is a GiDEL Intellectual Property that provides a simple and convenient way to connect an external *CameraLink* camera to GiDEL ***PROC boards. This connection is achieved via ***PSDB_CL*™** or ***PSDB_CL2*™** daughterboards.

A block diagram in the next section, Figure 1 and Figure 2, schematically shows the signal flow when using ***PSDB_CL*** and ***PROCCamLink IP***. The camera signals are processed in two stages: first by the ***PSDB_CL*** daughterboard and then by the ***CameraLink_Config*** module on the PROC board. The translated ready-to-use signals enter the user's module where they can immediately be operated by user's logic.

This system concept provides an easy way to connect to an external camera, while freeing the designer from having to deal with hardware connections and board constrains. Once the ***PROCCamLink IP*** has been set up, ***PROCWizard*** automatically connects the required signals to the designer's module. The signals entering the user's module are ready for immediate use and are arranged in the format the user has requested. No further data translation is needed.

For more information, please refer to ***PSDB_CL*** Data Book.

PROCCamLink IP Key Features

GiDEL PROCCamLink™ IP was designed to provide a simple and convenient way to connect an external camera to ***GiDEL PROC*** boards using ***PSDB_CL***™ or ***PSDB_CL2***™ daughter boards.

CameraLink IP key features include:

- ✓ Full support of all standard CameraLink modes (base, medium, full and double base modes)
- ✓ Automatic and complete connection of ***CameraLink*** to user's HDL module
- ✓ Serial Communication with camera
- ✓ Optional synchronization of all Camera Link inputs with the Base channel input clock
- ✓ Simple interface
- ✓ Optimization for easy control by hardware and software

PSDB_CL and *PROCCamLink* Connections' Block Diagram

This section schematically shows the signal flow when using ***PROCCamLink*** IP with ***PSDB_CL***. The camera data enters PSDB_CL daughterboard where it is converted from LVDS serial data to standard parallel TTL signals. These signals are then transferred to an FPGA on the PROC motherboard, where they enter the ***CameraLink_Config*** module. This module translates the signals and transports them over several buses to the top-level design. The top-level design connects these buses to user's entity/module where user can operate them.

Several configurations are available with PSDB_CL: **Base**, **Medium**, **Full** and **Double Base.** The block diagram below shows the signal flow when using Base, Medium or Full configuration.

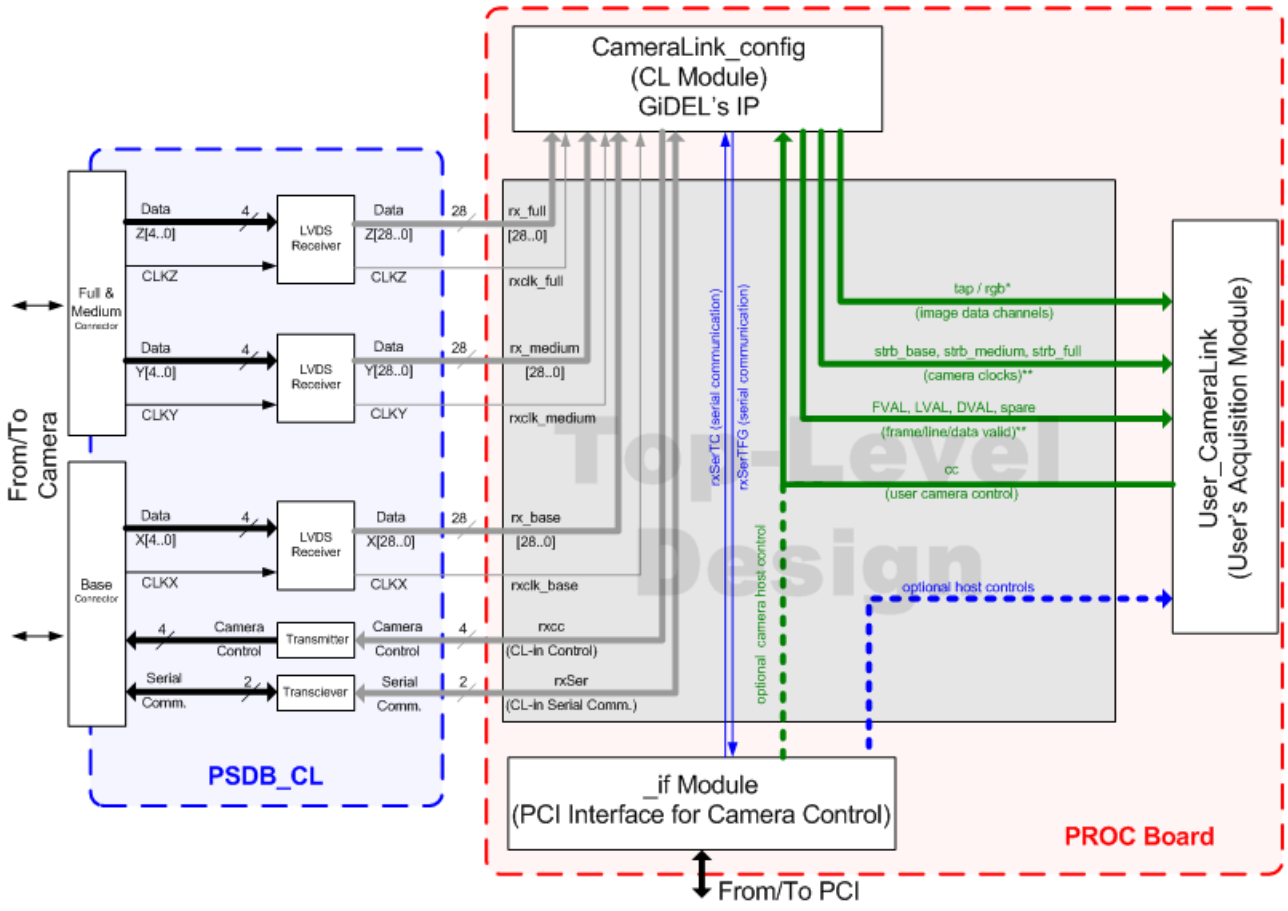
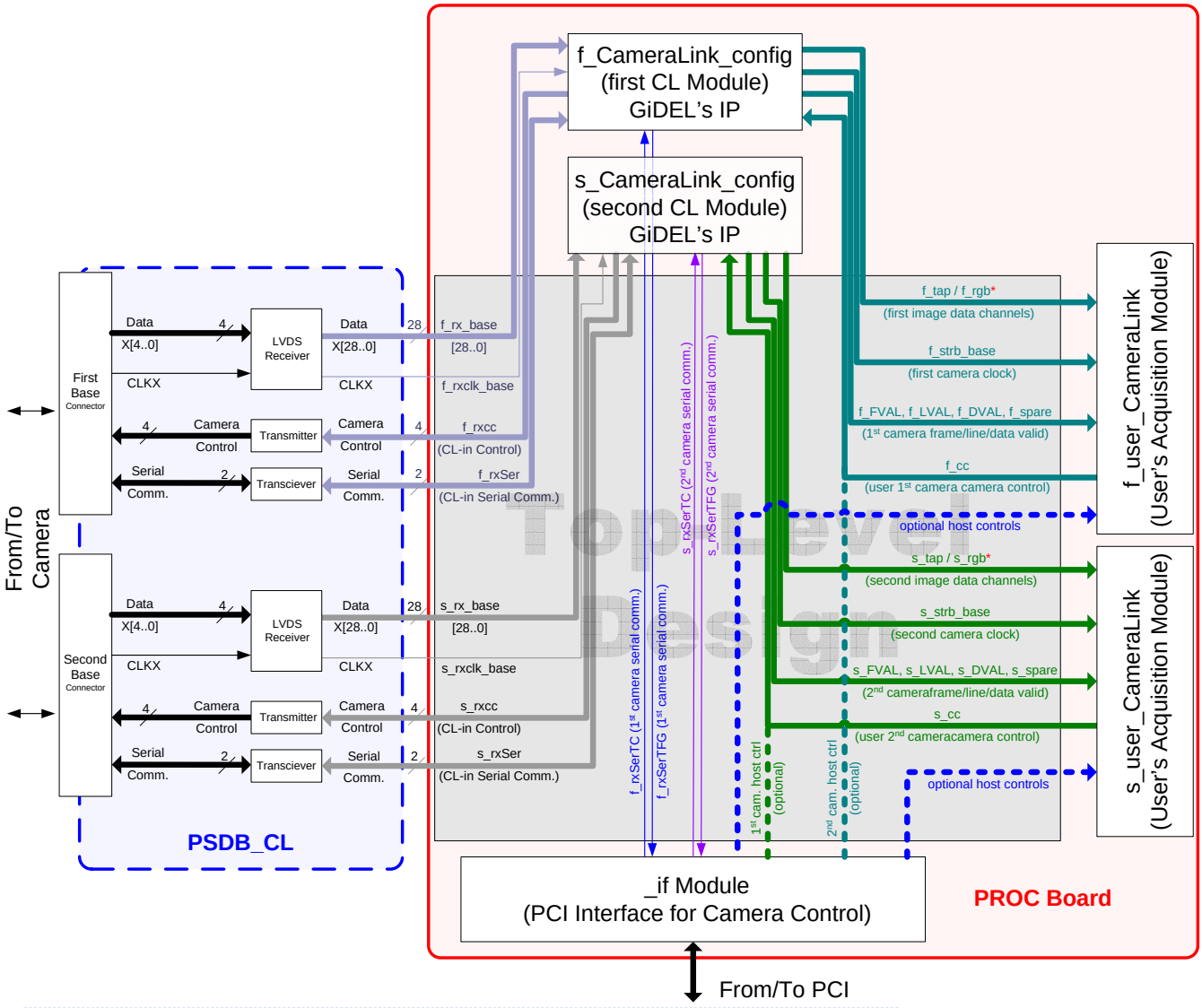


Figure 1: Signa flow for Base, Medium, and Full configuration

The block diagram below shows the signal flow when using Double Base configuration.



* Data channels may be tap8 / tap10 / tap12 / tap14 / tap16 / RGB24 / RGB30 / RGB36 in Base / Medium / Full modes, or tap8 / tap10 / tap12 / tap14 / tap16 / RGB24 in Double Base mode

** In Medium and Full modes, all the data transfers may be synchronized to the base channel. In this case, a single strobe signal and a single validation signal will enter the user's design, instead of separate signals for each channel as shown in the block diagram. To activate this option, select **Registered inputs** in ***PROCWizard*** while configuring the CameraLink IP.

Figure 2: Signal flow for Double Base configuration

GiDEL PROCWizard automatically generates all the units shown in the above block diagrams, as well as the top-level design. For more information, please refer to **PROCWizard User Manual**.

To set up the ***PROCCamLink*** IP, first enter the Configuration Screen in ***GiDEL PROCWizard***. The Configuration Mode is used to build designs in ***PROCWizard***. New items can be added to the design in this mode and existing items can be redesigned. To enter the Configuration mode, click the button in ***PROCWizard's*** toolbar, as shown in the figure below:

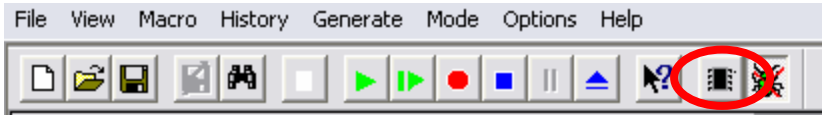


Figure 3: Configuration Mode Icon

Once in Configuration Mode, you will see the design you are building represented by a tree of items.

To learn more about these items, please refer to ***PROCWizard*** User Manual.

To add ***PROCCamLink*** to your design, choose the **IC** item that represents the FPGA device to which the ***PSDB_CL*** daughterboard is connected. Right-click on this **IC** and choose **IP Core → Camera Link** from the pop-up menu. This will open a dialog box shown in the Figure 4. This dialog box enables the user to configure the ***PROCCamLink IP***.

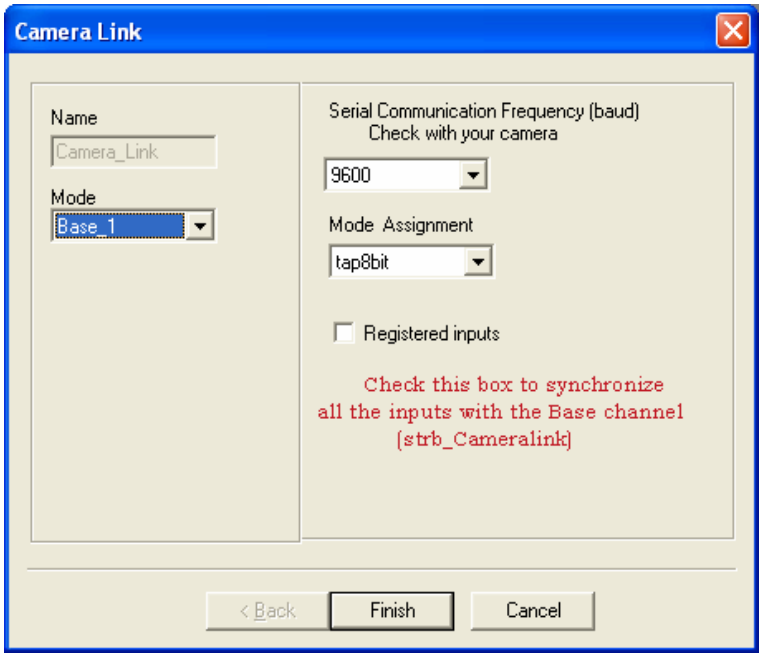


Figure 4: PROCCamLink Configuration Dialog

The following parameters are defined in this dialog box:

- **Mode**: defines the Camera Link mode to be used:
  - **Base**, **Medium** or **Full** Camera Link configuration;
  - **Base_1** or **Base_2** for Double Base Camera Link configuration;
- **Serial Communication Frequency**: sets the serial communication frequency with the camera (from 9600 to 921600 baud)
- **Mode assignment**: defines output data width and the output standard:
  - **tap8bit**, **tap10bit**, **tap12bit**, **tap14bit**, **tap16bit** or **RGB24bit** for Base mode
  - **tap8bit**, **tap10bit**, **tap12bit**, **RGB30bit** or **RGB36bit** for Medium mode
  - **tap8bit** for Full mode
- **Registered inputs**: checking this checkbox synchronizes all Camera Link inputs with the Base channel input clock (not only sampling but full synchronization). In this case, a single strobe signal and a single validation signal will appear in the top-level design, instead of separate signals for each channel.

For more details about Camera Link configuration, see **Specifications of the Camera Link Interface Standard for Digital Cameras and Frame Grabbers**.

Clicking **Finish** adds the ***PROCCamLink*** IP to the design.

Note

A Camera Link IP with all its elements can be cut and pasted or copied and pasted to another IC (provided that the target IC has Camera Link Interface).

PROCCamLink design consists of **camlink_config** and **user_camlink** subdesigns. **Camlink_config** is the CameraLink interface unit that provides the mechanisms required to communicate with a camera. User cannot alter this unit or add functionality to it. In order to add functionality or user's logic, one must use the **user_camlink** subdesign. This unit is added especially for that purpose. All the CameraLink signals (data, clocks and control signals) enter this unit to allow maximum flexibility.

The structure of Camera Link design is shown in the figure below.

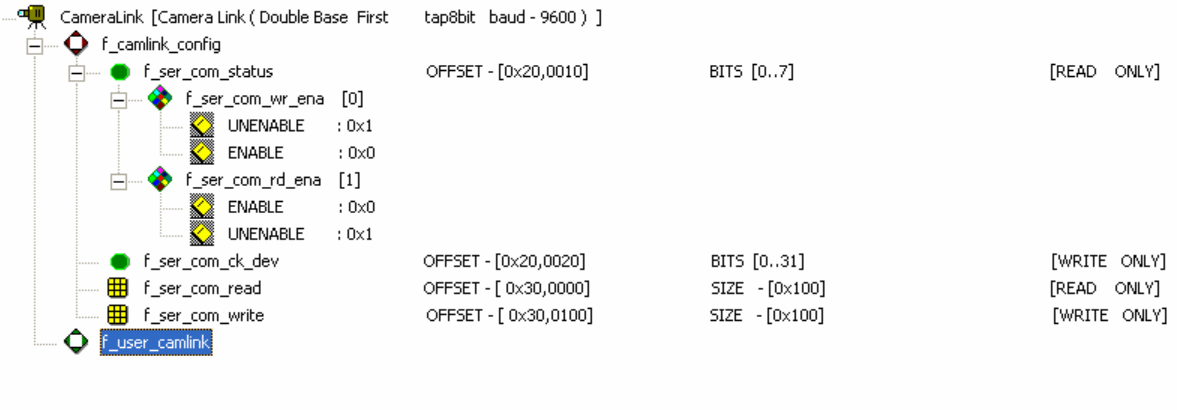

CameraLink [Camera Link (Double Base First tap8bit baud - 9600)]
f_camlink_config
f_ser_com_status OFFSET - [0x20,0010] BITS [0..7] [READ ONLY]
f_ser_com_wr_ena [0]
UNENABLE : 0x1
ENABLE : 0x0
f_ser_com_rd_ena [1]
ENABLE : 0x0
UNENABLE : 0x1
f_ser_com_ck_dev OFFSET - [0x20,0020] BITS [0..31] [WRITE ONLY]
f_ser_com_read OFFSET - [0x30,0000] SIZE - [0x100] [READ ONLY]
f_ser_com_write OFFSET - [0x30,0100] SIZE - [0x100] [WRITE ONLY]
f_user_camlink

Figure 5: PROCWizard Configuration Mode Window with Camera Link IP

Right-clicking on **user_camlink** allows the designer to add items to this subdesign. Here, the user can add clocks, registers, memories and register groups. In addition, the user can connect this subdesign with ***PROCMultiPort IP*** Ports.

For more information on subdesigns, see paragraph **Module (entity),** chapter 4 in **PROCWizard User Manual**. For more information on PROCMultiPort IP, see paragraph **IP Core – MultiPort**, chapter 4 in **PROCWizard User Manual**.

User can access components (registers, memories and register groups) of both **camlink_config** and **user_camlink** subdesigns in ***PROCWizard* Debug mode**. The Debug Mode is used to debug designs in real-time using ***PROCWizard***. Data can be written / read on-the-fly to / from registers and memories that appear in the design. To enter the Debug mode, click the button in ***PROCWizard's*** toolbar, as shown in the figure below:

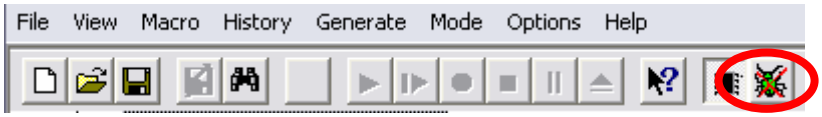


Figure 6: Debug Configuration Mode Icon

Once in Debug Mode, you will see the design you are building represented by an item tree, as shown in Figure 5. To access registers/memories, use the **Read** and **Write** buttons and the **Data(Hex)** field.

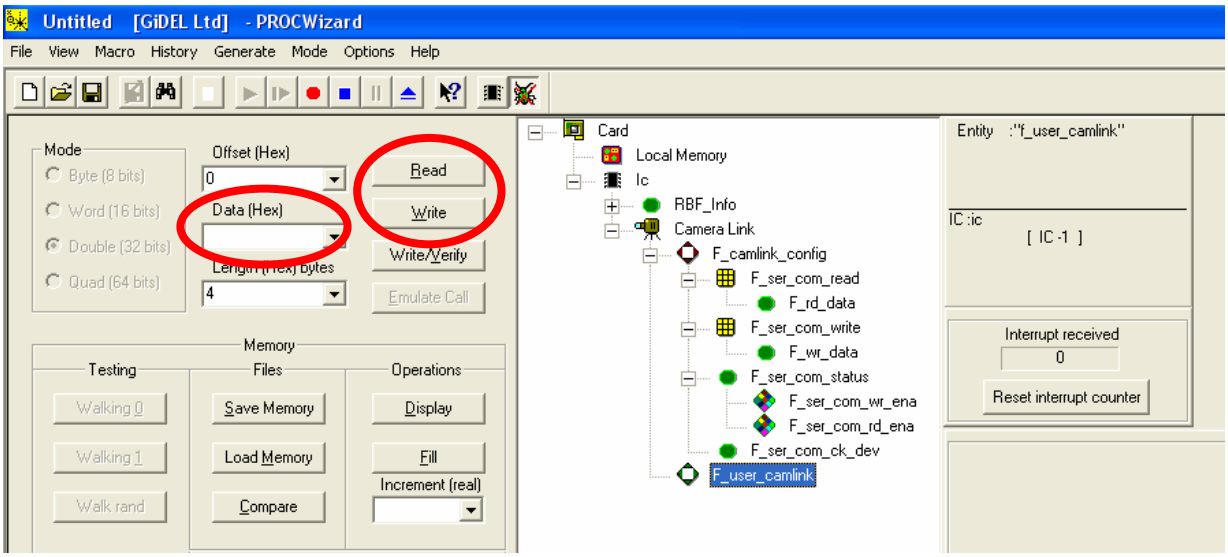


Figure 7: PROCWizard Debug Mode Window with Camera Link IP

Components (registers and memories) of **camlink_config** subdesign allow user to debug Serial Communication to camera:

- Register **Ser_com_ck_dev** is used to change Serial Communication frequency on-the-fly. The value for this register is calculated as follows:

  Ser_com_ck_dev_value = PCI_clock_frequency **(Hz)** / *Serial_communication_frequency* **(baud)**

  For example: if the PROC Board is installed in PCI 64 (66 MHz) slot and Serial Communication frequency must be 9600 baud then the value that should be written to this register is:

  Ser_com_ck_dev_value = 66000000 / 9600 = 6875 = 1ADB **(Hex)**

Note PROCWizard always uses hexadecimal values when reading / writing registers / memories.

- Fields **Ser_com_wr_ena** and **Ser_com_rd_ena** of **ser_com_status** register indicate whether the register is ready for the user to read/write data from/to camera (0 – ready, 1 – not ready)
- Register **wr_data** of **ser_com_write** register group enables user to write data to the camera (each write transaction transfers 8 bits of data)
- Register **rd_data** of **ser_com_read** register group enables user to read data from the camera (each read transaction accesses 8 bits of data)

In addition, user may use the Debugging Screen to read / write data to ***PROCCamLink*** user's unit (**user_camlink**) and / or to other units.

To learn more about debugging using PROCWizard, please refer to chapter 6 in **PROCWizard User Manual**.

PROCCamLink IP Initialization Methods

This section briefly describes the methods of ***CameraLinkInit*** class. This class provides an API that can be used for implementation of an interface with ***PSDB_CL*** daughterboard. An object of this class is automatically generated by ***GiDEL PROCWizard*** if a ***PROCCamLink*** core is added to the design.

For more detailed description of these methods, please refer to the Proc API document.

CameraLinkInit class provides the following methods:

- **CameraLinkInit**

  This is the **CameraLinkInit** object constructor.

- **WriteData**

  The **WriteData** method writes data to serial communication port.

- **ReadData**

  The **ReadData** method reads data from serial communication port.

- **SetWaitParam**

  The **SetWaitParam** function sets the polling rate and timeout period for **WriteData** and **ReadData** functions.

- **SetBaud**

  The **SetBaud** function sets the baud rate for the serial communication. This function changes the values of **CameraLinkInit** internal members rather than actually changing the baud rate. In order to physically change the port baud rate, call **Initialize** method immediately after calling the **SetBaud** method.

Initialize

This method adjusts the port baud rate according to the values of **CameraLinkInit** internal members.

GetStatus

This method returns the status of **CameraLinkInit** object. The status is one of the following:

- **CLINK_OK**
  Last CameraLink operation was successful.
- **CLINK_ERROR_INIT**
  Last CameraLink operation could not be performed because the **CameraLinkInit** object was incorrectly initialized.

  This error may occur if the Create function is called with incorrect parameters.
- **CLINK_ERROR_TIMEOUT**
  Last CameraLink operation has timed out.
- **CLINK_ERROR_INVALID_INPUT**
  Last CameraLink operation was not performed because the input value was incorrect.

Create

This method is called by other methods of the **Proc** class. This is an internal method and is not intended to be called by user.

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